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# Agricultural Research



## Plum Island Revisited

African swine fever has broken out recently in Brazil, the Dominican Republic, and Haiti. Earlier this year, it was again diagnosed in Cuba. As a control measure, every hog in the Dominican Republic will be slaughtered by August. Foot-and-mouth disease, probably the most explosively contagious animal plague in the world, continues to exist in nearly every large land mass of the world except North and Central America, Australia, and New Zealand. Rinderpest, fowl plague, contagious bovine pleuropneumonia, and many other highly dangerous livestock diseases continue to hold back production and distribution of livestock and animal products, impacting world food production and nutrition.

And in a world where expanding travel continues to increase the risk of disease transmission, these foreign livestock diseases represent a continuing threat to American livestock.

The United States' first line of defense against these potentially ruinous invaders is the Plum Island Animal Disease Center. The island, a former coast artillery post in Long Island Sound, is the only research center in the country devoted to the study of contagious foreign animal diseases. Its natural isolation is supplemented with highly sophisticated procedures to insure that the work with these virulent viruses and bacteria is carried out safely.

For more than 25 years, the scientists who work on this Island have made major contributions to the basic understanding and ways for dealing with some of the world's least understood and most devastating animal diseases.

Plum Island scientists proved several years ago that one protein from the coating of the foot-and-mouth virus conferred immunity to the disease—but at the time, the complicated procedures needed to produce the protein made it too costly for practical use. Now, the laboratory is experimenting to see if recombinant DNA technology can be used to produce the protein vaccine safely and inexpensively. This research was highlighted in the August, 1976 issue of *Agricultural Research*, and is updated in the lead article of this issue.

The Center has also produced vaccines, control measures, and rapid diagnostic tests to help prevent or limit outbreaks of foreign animal diseases.

Plum Island continues also to carry on high-priority research on a wide array of current animal disease problems. African swine fever, for example, has a high priority because of several outbreaks in other parts of the world in recent years and its recurrence in Cuba underscores this concern. The Center staff is hopeful that recombinant DNA techniques will prove successful against this most deadly of swine diseases.

Plum Island has been a key element in protecting this country's livestock since its establishment in 1954. In addition to its basic research on contagious foreign disease, the Center provides diagnostic support to USDA's Animal and Plant Health Inspection Service (APHIS), and is involved in applied research on virus survival in animals and animal products, methods of virus inactivation, and development of vaccines and other control measures.

The Center scientists also test live-animal semen before it can be imported, assess hazards from imported animal products, produce diagnostic materials for other laboratories, and train U.S. and some foreign personnel in diagnostic techniques.

### History

Plum Island was named by early explorers who discovered beach plums growing along its shores. The U.S.

government bought it in the 1890's to establish Fort Terry as a coastal observation and artillery post. Fort Terry was de-activated after World War II and the 800-acre island was idle until USDA used it as an isolation site for research.

The island is ideal: It is close enough to New York City for needed supplies and travel connections; large enough for a self-contained facility; and small enough for easy control. The only boats that connect the shores across the 1½-mile channel belong to the Center itself, which has its own harbor facilities and warehouse at Orient Point, Long Island for incoming supplies.

### Safety Precautions

Each animal to be used for testing at Plum Island is rigidly screened for good health. Animals that enter the Plum Island buildings through double-doored air locks stay there.

In the laboratory, the animals are kept in separately ventilated isolation rooms. These rooms are sealed from the outside world—and from each other—by air locks and biocontainment techniques.

Casual visitors are never allowed on Plum Island. Scientists and invited guests who do get to the island must agree to comply with all biological safety regulations—and to stay away from susceptible animals for specified periods of time after they leave.

Only laboratory clothing may be worn in the facilities, and everyone must remove the laboratory clothing and shower before leaving.

Work with viruses is done in enclosed "laminar flow biocontainment cabinets." Liquid wastes are heat-decontaminated before discharge. Burnable wastes are incinerated. Non-burnable wastes are sterilized overnight and then buried on the island.

Plum Island may be isolated from the rest of the world, but the results of the work that is conducted there have worldwide impact—and benefits.

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Editor: Patricia Loudon  
Assistant Editor: Michael A. Meliker  
Photography Editor: Robert C. Bjork  
Art Director: Deborah Shelton  
Cover Art: Lisa M. Bell

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Magazine inquiries should be addressed to: The Editor, SEA Information Staff, Room 3139-S, USDA, Washington, D.C. 20250. Telephone: (202) 447-6133.

Bob S. Bergland, Secretary  
U.S. Department of Agriculture

Anson R. Bertrand, Director of  
Science and Education

Terry B. Kinney, Jr.  
Administrator  
Agricultural Research

Photos pp. 11, 12, 13, 14  
courtesy Grant Heilman.

Cover: Aflatoxin in corn may be brought under control by using other fungi to neutralize *Aspergillus flavus*, the aflatoxin producing mold. Scientists at the SEA Northern Regional Research Center are studying the interactions between *A. flavus* and other fungal populations of corn's mycofloral community. Our story begins on page 8 (PN-6807).

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# Recombinant DNA Techniques for Vaccine Production

Quarantine and mass destruction of livestock associated with an outbreak of foot-and-mouth disease (FMD) have not been seen in this country since 1929. But FMD is still the biggest disease threat to our livestock. To date, FMD vaccines have not proven to be as reliable as some other vaccines in preventing disease.

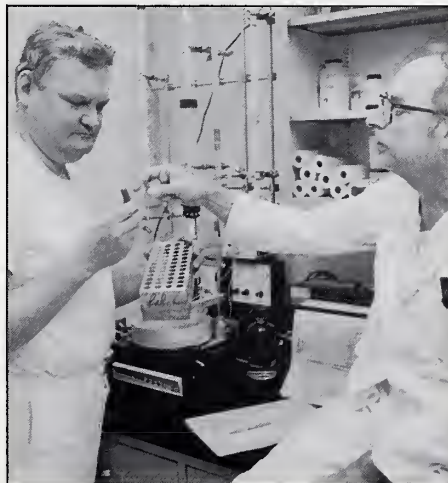
Now, however, scientists at SEA's Plum Island Animal Disease Center, off the coast of Long Island, N.Y., are using recombinant DNA technology in a research effort to produce a safe, effective, and inexpensive FMD vaccine. (Recombinant DNA technology is a form of genetic engineering whereby a single gene or a small series of genes from one organism are inserted into the DNA of another organism.)

The project, headed by SEA biochemist Howard L. Bachrach at Plum Island, is in cooperation with scientists from Genentech, Inc., a San Francisco-based company.

Using recombinant DNA techniques, the scientists are attempting to reproduce a fraction of the FMD virus coat. The fraction, called VP<sub>3</sub>, is one of four proteins in the FMD virus coat. Bachrach and his research colleagues at Plum Island demonstrated in 1975 that VP<sub>3</sub> is noninfectious, but capable of producing immunity in livestock.

Plum Island director Jerry J. Callis, proposed the research project to the National Institute of Health's (NIH) Recombinant DNA Advisory Committee (RAC). The RAC recommended that the first phase of the research could be carried out and this recommendation was accepted by NIH director Donald S. Fredrickson, M.D., in January 1980.

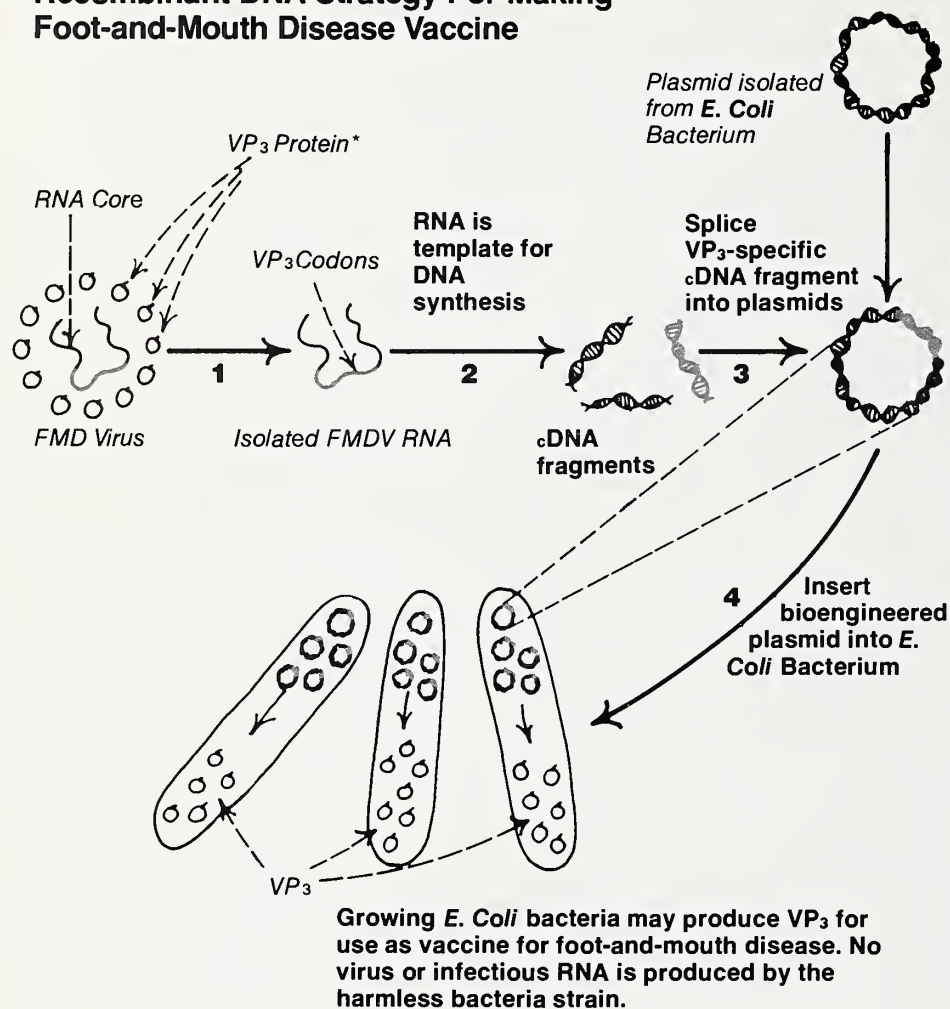
Opposite page: Protein, taken from the surface protein coat of foot-and-mouth disease virus, is isolated, purified, and injected in animals. Veterinarian Donald Morgan inoculates surface protein VP<sub>3</sub> to determine if the steer will develop immunity to the disease (0480W427-3A).



Above: Biological lab technician Tom Fischer (left) and lab chief Howard Bachrach subject VP<sub>3</sub> protein to sequencing procedures to determine its primary structure. This information is needed for devising a method to produce the VP<sub>3</sub> immunizing protein by recombinant DNA technology (0480W426-24A).

Left: Highly purified virus protein must be isolated and characterized in order to determine what part of the protein coat serves as the immunogen. Lab technician Karl Axelson and Howard Bachrach examine a sample of purified VP<sub>3</sub> before biochemical analysis to determine its amino acid sequence (0480W426-10A).

## Recombinant DNA Strategy For Making Foot-and-Mouth Disease Vaccine



\*VP<sub>3</sub> is the protein from the shell of the virus which can act as a vaccine for immunizing livestock against foot-and-mouth disease. The idea outlined above is to make this VP<sub>3</sub> protein without making any virus or infectious RNA.

This is the first time the RAC approved the use of recombinant DNA technology to produce materials to be used in manufacturing a vaccine against a Class 5 pathogen. (Class 5 is the U.S. Center for Disease Control's ranking which is reserved for pathogens that infect domestic animals outside of the U.S.)

The Plum Island scientists produced the first FMD subunit vaccines by conventional techniques from whole viruses grown in the laboratory at Plum Island (*Agricultural Research*, August 1976, p. 7). The coats of the viruses were removed, the VP<sub>3</sub> protein isolated, and a vaccine made—a tedious, time-consuming process.

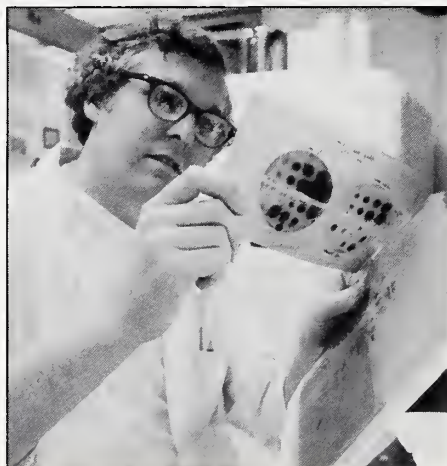
Although these first subunit vaccines were effective, the procedures for obtaining the VP<sub>3</sub> subunit made such vaccines too costly for practical use. However, recombinant DNA techniques may be successful in mass producing the critical VP<sub>3</sub> at a very reasonable cost.

In their research, the SEA and Genentech scientists are using the bacteria *Escherichia coli* K-12 as the host for reproducing the VP<sub>3</sub>.

The scientists will take the VP<sub>3</sub> genes of the FMD virus (made of RNA genes) and by adding an enzyme, make a complementary DNA master copy. The DNA genes will then be inserted into a naturally occurring bacterial plasmid (pBR322) of *E. coli*. The inserted DNA will, if all goes as expected, then order the *E. coli* K-12 to mass produce the VP<sub>3</sub> proteins for the FMD vaccine. (The K-12 strain of *E. coli* grows only on special media and is not free-living outside the laboratory.)

The first phase of the research, which uses the viral RNA, is being carried out in Plum Island facilities where the containment level is even more stringent than that recommended by the RAC. Also, Plum Island is only one of a few places in this country where Class 5 agents can be studied and the only place where FMD virus can be researched.

Microbiologist Douglas Moore inspects auto-radiograms of bacterial colonies which may produce VP<sub>3</sub>. This is an important step in the isolation of recombinant DNA molecules which will eventually be used to mass produce foot-and-mouth disease vaccine (0480W431-10A).





Mass production of an FMD subunit vaccine would be of enormous value to the U.S. livestock industry. "Because foot-and-mouth disease is not present in this country, U.S. laboratories are not permitted to produce conventional vaccines for this disease," Callis said. "If recombinant DNA technology proves useful in making an FMD vaccine, the method could be adopted for vaccine production in our own country should it ever be needed."

This would mean the U.S. would have a ready supply of vaccine for emergency use. Also, the vaccine could be stored indefinitely and would not have to be discarded and replaced every 1 to 2 years as existing FMD vaccines must be.

An effective subunit vaccine would be of great value not only to our own

country, but also to countries all over the world—especially those in which a vaccination program plays a major role in controlling FMD.

A subunit vaccine does not need refrigeration and therefore can be transported and stored even in remote areas of the world where refrigeration facilities are not available.

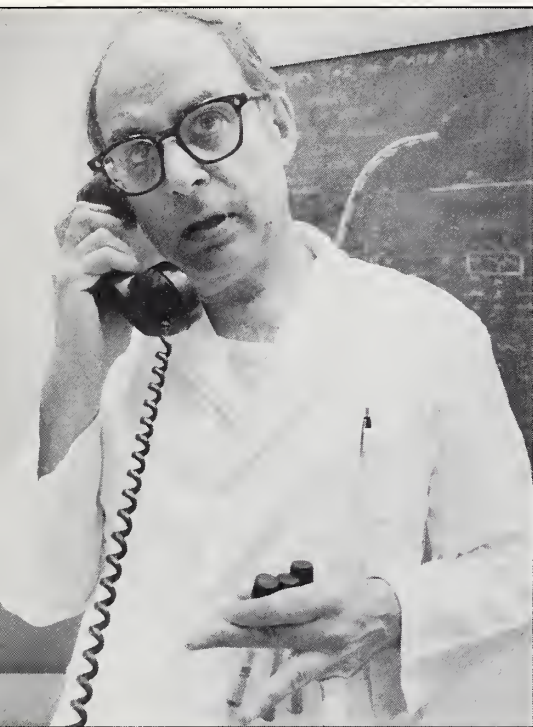
"If the Plum Island-Genentech efforts to mass produce a subunit vaccine prove successful," says Dr. Bachrach, "it could greatly increase the world supply of meat, meaning better nutrition for more people."

Dr. Howard L. Bachrach is located at the SEA Plum Island Animal Disease Center, P.O. Box 848, Greenport, Long Island, NY 11944.—(By Mary Ellen Nicholas, SEA, Beltsville, Md.)

Working in one of PIADC's high containment hoods, microbiologist Douglas Moore tries to identify a bacterial plasmid containing the proper complementary DNA sequence which will produce foot-and-mouth disease VP<sub>3</sub> (0480W429-11).

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## Foot-and-Mouth Disease



**F**oot-and-mouth disease (FMD) is the most serious disease of livestock in the world. Cattle, sheep, pigs, goats, and other cloven-footed animals are its prime target, although it affects more than 33 species of animals.

The disease is characterized by the formation of blisters on the mucous membranes of the mouth, on the nose, and around the top of the hoof. The blisters break, leaving raw, eroded areas. The blisters cause animals to salivate heavily and make eating and walking painful.

Affected animals may cease eating and spend much of their time lying down, causing a drastic reduction in milk production and a severe loss of weight.

Although the mortality losses from FMD are generally less than 5 percent, overall losses in milk and meat production and in the cost of controlling the disease probably amount to billions of dollars.

Indirect losses in the form of disruption of agricultural industry, lost foreign markets, and restriction on livestock events are estimated to be 10 times as great as the direct losses. Only four major livestock producing areas in the world are free of FMD: North America, Central America, Australia, and New Zealand.

FMD is caused by an extremely small virus of which there are seven immunological types and at least 65 subtypes. Animals immune to one type are susceptible to the other six types.

The virus can be spread by animals, people, or materials that come in contact with susceptible animals. The virus is highly contagious and can survive under a wide range of conditions outside of the animal's body.

There is no known treatment for FMD. Currently, the disease is controlled with vaccines in countries where it is endemic, and by quarantine and eradication in countries where there are periodic outbreaks.

Each year, FMD vaccines equivalent to 2.4-billion monovalent doses are manufactured. These vaccines are variable in their ability to prevent FMD.

Present overall effectiveness of a vaccination program is directly related to the quality of the vaccine and the effectiveness of control measures in the field, including surveillance of the movements of animals and disinfection of the premises where there have been infected animals. Slaughter and indemnity programs are currently the only sure way to eradicate FMD.—

(By Mary Ellen Nicholas, SEA, Beltsville, Md.)



Upper left: Howard Bachrach, chief scientist at PIADC, talks with scientists at Genentech, Inc., cooperators on the VP<sub>3</sub> cloning project, about results of the most recent recombinant DNA experiments at Plum Island (0480W428-3A).

Left: The Plum Island Animal Disease Center lies off the eastern end of Long Island, thus providing natural isolation for research with exotic animal diseases. It is the only facility of its kind in the country (0476X341-19).

# 244 FBI to Adopt Animal ID System [ 1, 2 ]

SEA research aiding crime prevention? Yes! The FBI plans to use the Angle System, a SEA-developed numeral system for identifying animals, to trace lost or stolen horses.

Each year, thousands of these horses are slaughtered against the wishes of their lawful owners. The primary reason for this tragedy is that there has been no universal system for identifying animals. Current identification systems vary from state to state and country to country.

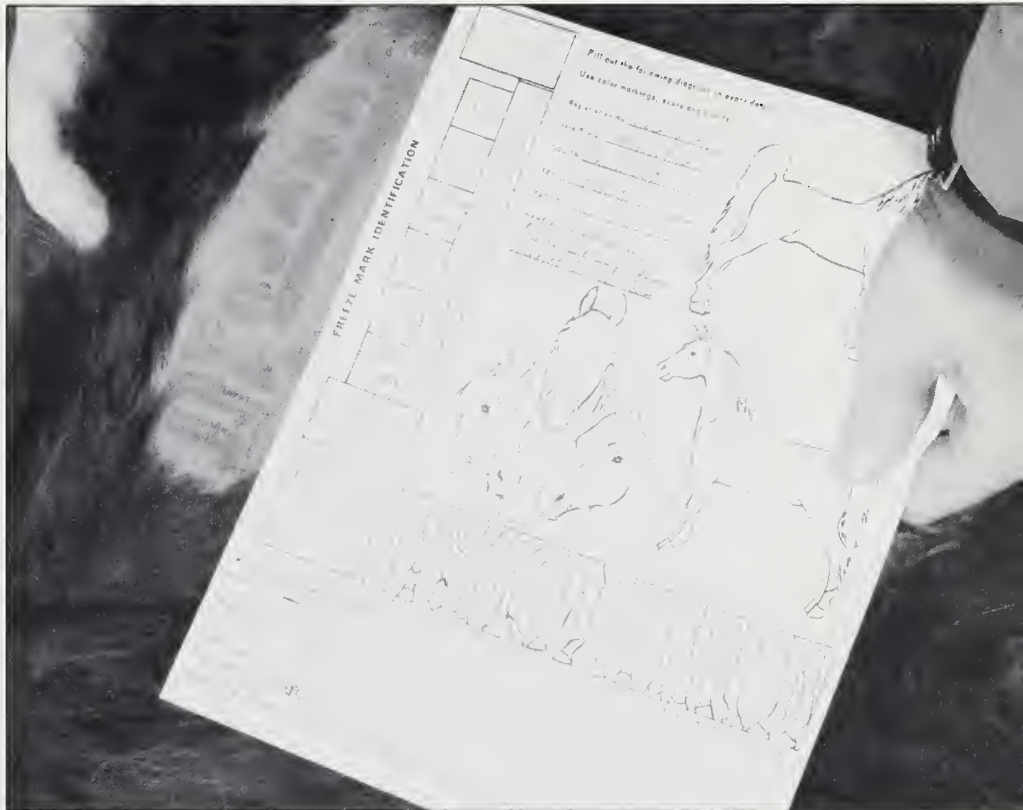
A giant step towards ending this problem for the horse industry was taken by SEA veterinarian R. Keith Farrell, Pullman, Wash., when he developed the Angle System (see *Agricultural Research*, February 1975, p. 9).

Using a combination of right angles and straight lines, the Angle System provides a permanent, unalterable identification code that readily lends itself to a computerized data retrieval system.

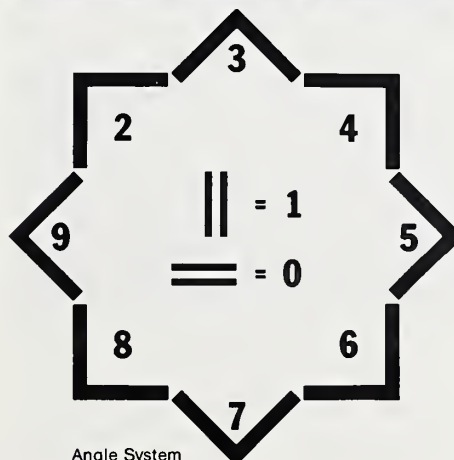
Farrell has since refined the system for use in identifying every horse registry, and the year of birth and individual number of any horse within a given registry. The FBI is putting Farrell's Angle System into their national registration computer. If a horse is lost or stolen, local law enforcement officials can give the horse's identification code to the FBI's National Crime Information Center, and law authorities all over the country can be alerted to watch for that animal at their local slaughterhouses.

A program testing this idea is currently underway in the state of Washington. If successful, Farrell's Angle System might also aid insurance companies and horse racing officials.

Dr. R. Keith Farrell is located at the Animal Disease Research Unit, Washington State University, Pullman, WA 99164.—(By Lynn Yarris, SEA, Oakland, Calif.)



Above: Horse registries and associations adopting this alpha-angle system of freeze-marking use a code composed of an initial alpha character identifying the association and a series of angles designating the horse's birth date and identification number. According to the code (diagramed below), the marking stamp above represents a horse of Appaloosa registry, born in 1972, with identification number 163132. Applied to the registry form with ink and on the animal by freeze-marking, the symbols become the horse's lifetime identification. Welts caused by the intense cold are painless and disappear a few hours after freeze-marking (0473W339-16).



Upper left: A technician's electric clippers reveal a perfect and unalterable Angle System freeze-mark applied to this pony just 6 months before by Keith Farrell. (0473W339-32).

## Molds Compete to Control Aflatoxin 21, 2, 3, 4



Above: Microbiologist Donald Wicklow examines effects of *Aspergillus niger* on growth of aflatoxin producing mold *Aspergillus flavus* (0180X065-35).

Opposite page: Corn crops in different regions of the U.S. are susceptible to different forms of mycotoxin contamination, including aflatoxin, which occurs more commonly in warmer corn-growing climates.

Competition with each of two molds stopped a third, [*Aspergillus flavus*], from producing aflatoxin in corn in a laboratory study. 21, 2, 3, 4

Competition with 10 other molds that had a 5-day growing start also prevented *A. flavus* from producing the toxin and carcinogen named after it.

These studies of interference competition in corn field ecology open the door for Donald T. Wicklow, SEA microbiologist, in learning how life processes inhibit aflatoxin production. The studies introduce microbial ecology, a component missing from earlier studies on corn genetics, insects, and weather as causes of variation in aflatoxin production in corn.

"Our research program now recognizes the potential significance of interactions among ecologically specialized fungal colonists of cereal grains, both before and after harvest, in affecting aflatoxin contamination," Wicklow says.

"No aflatoxins were detected," he says, "when *A. flavus* was paired against either [*Aspergillus niger*] or [*Trichoderma viride*]." 3

*A. niger* and *T. viride* are molds commonly found on corn at harvest. They and 11 other common fungi—10 molds and a yeast—grew in individual competition against *A. flavus* on sterilized corn kernels in a study by Wicklow, Clifford W. Hesseltine, Odette L. Shotwell and Gordon L. Adams at the Northern Regional Research Center, Peoria, Ill.

"Aflatoxin contamination was substantial in the 11 other simultaneous pairings," Wicklow says. Mean values ranged from 676 to 3765 parts of aflatoxin per billion parts of corn (ppb) when *A. flavus* competed against the yeast or any single mold except *A. niger* or *T. viride*. (As little as 20 ppb of aflatoxin makes corn unfit for feed or food by Federal standards.)

When the other fungi had a 5-day growing start on the corn, *A. flavus* produced aflatoxin only while growing with the yeast, Wicklow says, although it grew successfully with some of the other molds.



The study examined the effect of ecologically specialized fungi on aflatoxin production. "Fungal populations sharing a common resource over evolutionary time will specialize," Wicklow says.

Some of the fungi in the study, for example, are from groups that rapidly colonize plant leaves in nature. Some are from groups that start late but persist through leaf drying and plant litter fall. Some of the fungi, plant pathologists suspect, start in seed, grow in the plant vascular bundles and end up in the new seed. Still others, including *A. flavus*, *A. niger* and *T. viride*, can grow and sporulate in stored seed, then hitchhike with insects to the fields.

Wicklow says the sequence in which *A. flavus* and other fungi colonize corn kernels and the biological properties

of the other fungi may determine conditions for producing aflatoxin. The laboratory results "invite our attention," he says, "to the potential importance of coexisting species in determining which biosynthetic pathways are available to *A. flavus*."

Against *T. viride*, a strong antagonist, *A. flavus* could not compete. It failed to grow on the corn kernels. "In contrast," Wicklow says, "*A. niger* is a weak antagonist of *A. flavus*. The two molds grew together and produced equivalent numbers of spores on sterile kernels, yet no aflatoxin was detected.

"What's *A. niger* doing to the substrate (corn) in which *A. flavus* formerly could produce abundant quantities of aflatoxin?

"Is *A. niger* producing something like an antibiotic or an enzyme that prevents *A. flavus* from synthesizing aflatoxin?

"Does *A. niger* destroy aflatoxin?

"Might corn be bred to incorporate a similar mechanism that would inhibit the production of aflatoxin?

"Why does *A. flavus* produce aflatoxin? Is it a survival mechanism?"

Wicklow has observed that some storage insects appear to prefer grain not contaminated with aflatoxin although they can eat contaminated grain and live.

"The more we learn of these phenomena," he points out, "the better we will be prepared to prevent aflatoxin from contaminating grain."

Dr. Donald T. Wicklow is located at the SEA Northern Regional Research Center, 1815 N. University, Peoria, IL 61604.—(By Dean Mayberry, SEA, Peoria, Ill.)



Large-scale peanut flour production is now possible through adoption by the oilseed processing industry of a new heat and moisture treatment applied before removing the peanut oil.

This innovative process, developed by SEA scientists in New Orleans, minimizes "fines"—the major production impediment to increasing commercial production. Fines are extremely fine particles of seed that block up filter systems and drastically impede separating oil from the meal.

The new process offers a white flour which is bland and virtually free of raw peanut flavor. The flour has a protein solubility (an indicator of functional and nutritional values) of 85 percent.

Extremely high in protein (65 percent as compared with 12 to 14 percent in wheat flour), white peanut flour can be used in limited amounts in many foods. It increases their protein content, without affecting other properties such as flavor, color, or texture. However, peanut flour, as well as other oilseed flours such as cottonseed and soybean, cannot be used as a complete substitute for wheat flour in bakery products. It lacks gluten, which allows baked goods to maintain their structure once they have risen.

Currently, the only peanut flour produced on a limited scale commercially is tan in color with a protein solubility of less than 60 percent. The present system also generates high temperatures which damage protein quality.

SEA chemical engineers James J. Spadaro and Joseph Pominski, of the Southern Regional Research Center, developed the new process. They realized heat damage and fines were problems to overcome, but that heat was required to reduce raw peanut flavor and that fines could not be completely eliminated.

## 245 Nitrogen-Fixing for Peanuts

Their five-step process involves: 1) moistening the peanuts to 12 percent moisture, 2) heating them to 180° F and holding them there to 30 minutes while maintaining moisture content at 12 percent, 3) drying at 180° F to 6 percent moisture, 4) flaking treated kernels, and 5) removing oil by direct solvent extraction.

A laboratory study of processing conditions such as flake moisture and extraction time, and their effect on residual oil, showed the most important factors were flake moisture content and extraction time. Flake thickness was not significant.

In the pilot plant, the moistened, heat-treated peanuts were flaked to 0.008 inch thickness, then continuously extracted at 140° F. Extraction feed rates ranged from 62 to 130 pounds per hour; solvent-to-meal ratios were 2 to 1 and 3 to 1; and extraction times were 1 and 2 hours. Residual oil in the meal ranged from 1 to 1.8 percent, and the fines were as low as 0.2 percent—very acceptable levels.

The scientists also conducted solvent removal studies because, whatever the extraction method, some solvent tends to cling to the meal. They developed two methods to reduce residual hexane to acceptable levels of less than 60 parts per million.

Each method consists of 2 steps. The first step, common to both, involves heating the hexane-wet meal to 180° F under vacuum to reduce hexane content to less than 1 percent. The second step of method one calls for moistening the partially desolventized meal to 18 percent and heating to not more than 180° F for 30 minutes at atmospheric pressure. In the second step of method two, the meal moisture content is raised to 18 percent and the meal is steam sparged at 180° F under vacuum for 10 minutes to an hour.

James J. Spadaro and Joseph Pominski are located at the SEA Southern Regional Research Center, P.O. Box 19687, New Orleans, LA 70179.—(By Vernon Bourdette, SEA, New Orleans, La.)

**W**hat do peanut experts say about inoculating the plant with nitrogen-fixing bacteria?

It depends on the cropping history of the land, says SEA plant physiologist James E. Pallas, Jr., and University of Georgia horticulturist Craig S. Kvien. They recommend that if there has been a well-nodulated peanut crop within the last 5 years on the same land, do not inoculate. This land will usually contain enough nitrogen-fixing bacteria to cause nodulation on the plant's roots.

If the land has never been cropped to peanuts or has not been within 5 or 10 years, inoculation is recommended.

Many types of inoculants are available, say Pallas and Kvien. The safest, and one of the most convenient methods of inoculation is to use granular peat-based inoculants applied through the divided or separate insecticide box during planting. The generally recommended rate is 4 to 5 lbs. (2 to 2.5 kg) of granular inoculant per acre (0.4 hectare).

For best results:

- Buy the inoculant as close to planting time as possible. Buy only from dealers who refrigerate inoculants. Keep the inoculants stored in a cool place, somewhere between 37° and 50° F (3° to 10° C). Inoculants should never be stored at high temperatures.
- Check the expiration date. Don't buy last year's inoculant. Make sure the inoculant is in a well-sealed plastic or plastic-lined paper sack. Nitrogen-fixing bacteria will die if the carrier (such as peat) should dry out.
- Avoid preinoculated seeds and inoculants made with other than the granular or powdered peat. No experiments to date have shown any materials to be superior to peat under normal farming conditions.
- Carriers containing micronutrients, such as molybdenum, are likely to have less living nitrogen-fixing bacteria than a carrier without these extras.
- Coating the nitrogen-fixing bacteria onto a fungicide-treated seed decreases the bacteria's chance of surviving and forming nodules.



- Make sure the inoculant is for peanuts. Do not use a soybean inoculant on peanuts.

Field research aimed at improving nitrogen fixation in peanuts is currently being conducted at the Coastal Plain Experiment Station in Tifton, Ga., and at the Southwest Georgia Branch Station in Plains, Ga. Further supporting research is now underway in the Department of Horticulture, University of Georgia, Athens, and Southern Piedmont Research Center, Watkinsville, Ga. This research is supported in part by the Georgia Peanut Commodity Commission.

Dr. James E. Pallas is located at the SEA Southern Piedmont Research Center, Highway 53, P.O. Box 555, Watkinsville, GA 30677.—(By Peggy Goodin, SEA, New Orleans, La.)

## 214 Cranberry Girdler Control [ 1, 2, 3

✓ The sex pheromone (the sexual attractant) of the female cranberry girdler, also known as the sod webworm in grasses, has been identified and synthesized by SEA researchers. Pheromone bait traps are now available commercially for use against this insect pest. ↓

As larvae, girdlers bore into the crowns of cranberry and grass seed plants and feed from July through November. The insects can be found in dense field patches or bogs, feeding until all the plants are destroyed. Stands must be re-established to full production, which requires about 4 to 6 years for cranberries and 2 years for grasses.

Until now, efforts to control the girdler have been ineffective because growers could not detect infestations until larvae had begun feeding and crop damage became evident. Once housed inside plant crowns, larvae are generally protected from insecticides. Further complicating the problem is that some fields or bogs are infested every year, while others suffer damage only every 3 or 4 years.

A way to detect the presence and extent of cranberry girdlers' damage was needed. James A. Kamm, a SEA entomologist at Corvallis, Ore., and Leslie M. McDonough, a SEA chemist at Yakima, Wash., believed the sex pheromone of the cranberry girdler might do both jobs.

To identify the pheromone, Kamm hired nearly 50 members of different youth groups to collect mature larvae from a badly infested field. The larvae were taken to the laboratory and reared to adulthood.

Kamm then removed the tips from female abdomens, where the pheromone is produced, and put the tips in solvent.

Using this material and live moths, McDonough determined the pheromone components and synthesized the material for mass production. The pheromone was then used to bait traps in girdler-infested fields.

"After several years of field tests we



now have a very potent bait," says Kamm. "It looks like a single trap will give a good indication of the population density in a 2-1/2 to 5 acre area. Cool, cloudy weather can reduce the trap catch because the insects won't respond as well, but we can take this into consideration in evaluating trap counts."

To control girdlers in grasses, baited traps are dispersed in a field. When the average daily catch exceeds a given number of moths, damage to stands becomes highly likely, and the field should probably be treated with insecticide. Killing adult females that otherwise would have laid eggs prevents damage to the stand by larvae.

Pesticides cannot be used to control adult cranberry girdlers because their flight period coincides with the cranberry pollinating season of bees, and any pesticide used would kill bees as well as girdlers.

The water-pick cranberry harvesting method is well suited for girdler control and pheromone traps can be of immense help.

Most cranberry growers in the Pacific Northwest favor this method in which bogs are flooded and a machine is used to beat the berries off vines. Floating berries are then collected.

Growers can use pheromone traps to identify an infested bog, and keep it flooded for several weeks after the harvest. No harm is done to the cranberry plants, but girdler larvae drown. Growers can also use the traps to evaluate the effectiveness of their control measures.

Says Kamm, "Like most new things, growers will have to learn to use the pheromone trap to their best advantage, but that shouldn't take long."

Dr. James Kamm is located in room 2048-B, Cordley Hall, Oregon State University, Corvallis, OR 97331. Dr. Leslie McDonough is located at 3707 W. Nob Hill Blvd., Yakima, WA 98902.

✓ (By Lynn Yarris, SEA, Oakland, Calif.)

## Conservation Pays Three Ways 1, 2, 3.

1. [Runoff water conservation pays off three ways—in increased grain yield, increased water-use efficiency, and control of water erosion]

SEA soil scientist Ordie R. Jones studied land-shaping practices designed to maintain water on cropped areas; preventing runoff and utilizing the additional water to increase grain yields in a semiarid climate, such as the Southern Great Plains.

Scientists compared grain sorghum production on a narrow bench terrace (14 ft. wide), on a narrow conservation bench (28 ft. wide including a 14 ft. watershed), on various configurations of contour furrows which retained runoff, and on graded furrows which allowed runoff to escape.

Average precipitation of 16.8 inches per year over a 4-year period was 2 inches below normal. But even with these dry conditions, runoff water lost from graded furrows totaled 10.2 inches for the 4 years.

All conservation systems increased yields when compared to graded furrows, but narrow bench terraces resulted in greater yields and higher water use efficiencies than other conservation systems because less water was lost in tillage. Also, runoff control was achieved with minimum costs. By keeping land-forming systems narrow, leveling costs are reduced to a fraction of what would be required to level a large land area with deep cuts.

The narrow bench terrace and conservation bench terrace systems effectively controlled water erosion on the clay loam soil, retaining all the runoff from a 6-inch rain. However, contour furrows over-topped during the large storm. Jones cautions that on sloping fields, contour furrows should be used in conjunction with terraces to prevent or reduce soil erosion from large storms.

Dr. Ordie R. Jones is located at the SEA Southwestern Great Plains Research Center, Bushland, Texas 79012.—(By Peggy Goodin, SEA, New Orleans, La.)

This sorghum bench terrace in Bushland, Texas conserves rainfall for crop production. Excess soil moisture allows for annual, rather than biannual dryland cropping (PN-6805).





## Agrisearch Notes

### 214 Fire Fights Common Goldenweed, [C] 3

Controlled fire may be useful in reducing infestations of common goldenweed, a native shrub that has dramatically increased in density and abundance on improved pastures and rangelands of the South Texas Plains.

SEA range scientist H. S. Mayeux, Jr. says that "the species severely reduces forage production and has been linked to livestock poisoning." The response of common goldenweed to herbicide sprays is erratic and high rates of application are required for control.

Mayeux investigated the effect of cool-season burning on infested buffelgrass plots located near Laredo. The burnings, in December and February, resulted in 42 and 44 percent mortality of common goldenweed, respectively. Also, the canopy (cover) of the goldenweed was 85 to 91 percent less than preburn levels at the end of the growing season that followed burning.

Mayeux reported that "buffelgrass density was not adversely affected by the cool season burns and forage production was improved. Harvested, oven-dried forage was increased by 820

kilograms per hectare (730 pounds per acre) following the midwinter burn, and 320 kilograms per hectare following the early spring burn, compared to unburned plots."

"The burning definitely produces a decrease in weed density and vigor and an accompanying increase in forage production," he concluded.

Wayne T. Hamilton of the Department of Range Science, Texas A&M University, College Station, cooperated on the research.

Dr. H. S. Mayeux, Jr., is located at the SEA Grassland Soil and Water Research Laboratory, P.O. Box 748, Temple, TX 76501.—(By Bennett Carriere, SEA, New Orleans, La.)

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[C] 3  
Home Mothproof Spray. A newly developed home and garden spray has proven highly effective in mothproofing [woolen fabrics]. The water-based, pyrethroid combination spray is effective in protecting woolens against webbing clothes moths, black carpet beetles, and furniture carpet beetles. [C] 3

The sumithrin plus neo-pynamin insecticide formulations are effective as direct contact sprays for both adults and larvae. Tests reveal that adult insects which came in contact with the treated fabric were knocked down or killed. There was no evidence of further reproduction.

The new formulation has several advantages. They are effectiveness, low-mammalian toxicity, no objectionable odor, and no fabric staining. As a result, sumithrin plus neo-pynamin combinations merit consideration as a substitute for other insecticide formulations currently used to protect woolens in the home.

The formulation has received registration from the Environmental Protection Agency for this use. It will soon be marketed by a major manufacturer according to Roy E. Bry and Dr. Richard A. Simonaitis, of the SEA Stored-Product Insects Research and Development Laboratory, P.O. Box 22909, Savannah, GA 31403.—(By Eriks Likums, SEA, New Orleans, La.)